Determinants of Pain and Predictors of Pain Relief after Ulnar Shortening Osteotomy for Ulnar Impaction Syndrome

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Abstract

Background The purpose of this study is to characterize patient- and surgery-specific factors associated with perioperative pain level in patients undergoing ulnar shortening osteotomy (USO) for ulnar impaction syndrome (UIS). We hypothesize that preoperative opiate consumption, tobacco utilization, and severity of ulnar variance will be associated with less postoperative pain relief.

Methods All cases of USO between January 2010 and December 2016 for management of UIS were retrospectively reviewed. Patient demographics, smoking status, type of labor, and opioid utilization before surgery were recorded. Radiographic measurements for ulnar variance, radial tilt and inclination, as well as triangular fibrocartilage complex and distal radial-ulnar joint (DRUJ) morphology were assessed. Pre- and postoperative pain score were recorded. Regression analysis was performed to determine predictors of pain scores.

Results A total of 69 patients were included for the final analysis with a mean age of 44 years (range 17–73 years). Seventeen patients reported use of daily opioid medications at the time of surgery (25%). Patients who used opioid analgesics daily, active laborers, smokers, and patients involved in worker compensation claims had significantly less pain relief after surgery. Patients with osteotomy performed at the metaphysis had significantly more pain relief than patients that had diaphyseal osteotomy. Regression analysis identified tobacco utilization and anatomic site of osteotomy as independent predictors of postoperative pain.

Conclusion The results from this study identified smoking and location of osteotomy as independent predictors of postoperative pain relief. While smoking cessation is paramount to prevent delayed/nonunion it may also help improve pain relief following USO. The potential to achieve greater shortening with a metaphyseal osteotomy suggests that in addition to the mechanical unloading the carpus, pain relief after USO may also stem from tensioning the ulnar collateral ligaments of the wrist, the ECU subsheath, and the radioulnar ligaments.

Level of Evidence This is a Level III, therapeutic study.

Keywords
- pain predictors
- postoperative pain
- ulnar shortening osteotomy
- ulnar impaction syndrome

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Ulnar impaction syndrome (UIS) is well recognized to be associated with idiopathic or posttraumatic positive ulnar variance, which increases the mechanical load of the ulnar head against the carpal bones and results in ulnar sided wrist pain. Multiple techniques have been developed to help unload the ulnar side of the wrist and restore a neutral or slightly negative ulnar variance.[1–11] Specifically, ulnar shortening osteotomies (USO) has demonstrated reliable results with few complications.[12] Despite their widespread utilization, it remains unclear what factors impact patient outcomes.

In the published literature, there have been multiple attempts to identify predictors of persistent pain and/or pain relief following orthopaedic procedures, including total knee and hip arthroplasty,[13] spinal surgery,[14,15] hip fractures,[16] and ankle fractures;[17] however, few studies have specifically assessed these factors in upper extremity procedures. Nonunion or delayed union of the osteotomy site can occur up to 10% of the cases, which has been associated with decreased functional outcomes, revision surgery, and persistent pain.[18] Furthermore, implant irritation requiring removal can also negatively impact patient outcomes and increase overall costs.[19,20] Patient-specific characteristics, such as active tobacco utilization and worker's compensation have also been associated with negative postoperative outcomes.[21,22] The purpose of this study is to further characterize patient- and surgery-specific factors associated with pain level before surgery and postoperative pain relief in patients undergoing USO for UIS. We hypothesize that preoperative opiate consumption, tobacco utilization, and severity of ulnar variance will be associated with persistent pain following surgery.

Methods

The study consists of a retrospective review of patients that had ulnar-shortening osteotomy between January 2010 and December 2016. Inclusion criteria were patients who had ulnar impaction syndrome (UIS) due to idiopathic positive ulnar variance or due to positive ulnar variance as sequelae of healed shortened distal radius fracture (DRF). Exclusion criteria were immature skeleton as evidenced by open physes on radiographs prior to surgery, patients with congenital anomalies causing positive ulnar variance such as Madelung deformity and patients who had indications for distal radius osteotomy for correction of distal radius fracture malunion due to excessive dorsal tilt. This study was reviewed and approved by our institutional review board (IRB) from Wake Forest University School of Medicine.

Pain was recorded on the visual analog scale (VAS) of zero to ten. Pre- and postoperative functional scores including range of motion and the Quick Disabilities of the Arm, Shoulder, and Hand Score (Q-DASH) were recorded and analyzed. Other data collected included basic demographics such as gender, age, smoking status, worker's compensation status, and use of opioid medication before surgery. Use of opioids was considered positive when patients consumed any opioid medication on a daily basis for any condition; tramadol was not considered an opioid medication. Preanesthesia assessment in our institution requires narcotic medication check through the state's control substance reporting system for all patients undergoing surgery. Employment status was documented and categorized as laborer for patients whose work requires daily manual labor and nonlaborer as patients with mainly sedentary jobs. Other categories in employment status included retired, disabled, and unemployed but able to work.

The following radiographic features were measured—ulnar variance (UV), radial height, radial inclination, and volar tilt. Data obtained from radiographic features was analyzed as two separate cohorts—idiopathic UIS and UIS after DRF.

Triangular fibrocartilage complex (TFCC) injury was assessed either on magnetic resonance imaging (MRI) or arthroscopy, when both were present; the arthroscopy findings were used as definite diagnosis. Postoperative plain film radiographs were used to determine bony union. A nonunion was defined as <3 areas of bone bridging across the osteotomy on both posteroanterior and lateral radiographs at a minimum of 6 months, and with patient symptoms. All radiographs were retrospectively reviewed by a fellowship trained hand surgeon and correlated with the treating physician's clinic notes.

DRUJ morphology was assessed according to the method described by Tolat and classified into 3 types: type 1 DRUJ when the sigmoid notch is parallel to the long axis of the ulna $+/-$ 10° of zero, type 2 DRUJ when the sigmoid notch is obliquely oriented facing proximal with an angle of more than 10°, and type 3 DRUJ when the sigmoid notch is obliquely oriented facing distal with an angle of less than $-10°$.[23,24]

Data Analysis

Data was analyzed before surgery and 6 months after surgery. All continuous variables were tested for normality with Kolmogorov-Smirnov test and deemed appropriate for parametric testing. Bivariate analysis consisted of Pearson correlation coefficient to determine correlation between pain score and continuous variables and, unpaired Student *t*-test to compare pain scores between dichotomous variables. A minimum clinical significant difference in VAS pain score improvement was set to 1.4.[25] One-way analysis of variance (ANOVA) was used to compare pain score between categorical variables that had more than two categories and Bonferroni posttest correction was done to determine differences between categories. Covariates that showed statistical significance in the bivariate analysis ($p < 0.05$) or near significance ($p < 0.1$) were entered into a regression analysis in simultaneous entry fashion. A post-hoc power analysis was performed for primary (pain) and secondary (Q-DASH and ROM) outcomes. A two-tailed paired *t*-test for comparing pre- and postoperative scores was calculated based on $\alpha \leq 0.05$, and medium effect size for pain, Q-DASH, and ROM (determined from group parameters). A power of 82%, 82%, and 84% resulted from the study sample of 69 patients for pain Q-DASH scores and ROM measurements, respectively.

Cohort

The initial sample consisted of 106 patients. After exclusion criteria were applied, a total sample size of 69 patients was available for analysis. The sample included 37 females (54%) with a mean age of 44 years (range 17–73), 43 patients had idiopathic UIS (62%), and 26 had UIS secondary to DRF (38%); the dominant side was affected in 41 patients (59%). Of the 65 patients who had TFCC evaluation (56 on arthroscopy, 9 on MRI), 46 (67%) had a diagnosis of TFCC injury. Forty-one patients (59%) had classic diaphyseal osteotomy: 22 with the Trimed ulnar shortening system (Trimed Inc., Santa Clarita, CA), 14 with the Acumed ulnar shortening system (Acumed LLC, Hillsboro, OR), and 5 osteotomies had transverse freehand osteotomy and fixed with a Synthes 2.7 mm LCP (locking compression plate; DePuy-Synthes, West Chester, PA). Twenty-eight patients (41%) had metaphyseal osteotomy as previously described by Nunez et al,[26] Seventeen patients had patient-reported and EMR (electronic medical record)-confirmed use of daily opioid medications at the time of surgery (25%); 8 patients were prescribed opioids for chronic wrist pain, 5 patients for chronic back pain, 3 patients for chronic knee pain, and 3 patients for a combination of degenerative conditions including knee AVN, hip AVN, sequelae of pelvic fractures, and chronic pain syndrome of multiple sites. Complete demographic information is summarized in ►**Table 1**.

Table 1 Demographic information

	n (%)
Sex	
Male	32 (46)
Female	37 (54)
Diagnosis	
Idiopathic UIS	43 (62)
Secondary to DRF	26 (38)
Dominant side affected	
Yes	41 (59)
No	28 (41)
Smoker	
Yes	25 (36)
No	44 (64)
Worker compensation	
Yes	60 (87)
No	9 (13)
Opioid use before surgery	
Yes	17 (25)
Hydrocodone-acetaminophen	8
Oxycodone	7
Extended-release oxycodone	1
Extended-release morphine	1
No	52 (75)
Employment status	
Active laborer	23 (33)
Active nonlaborer	27 (39)
Unemployed	2 (3)
Disabled	4 (6)
Retired	5 (7)
Undocumented employment status	8 (12)
TFCC injury	
Yes	46 (67)
No	19 (27)
Unknown	4 (6)
Type of TFCC injury	
Central	35 (76)
Ulnar avulsion	2 (4)
Distal avulsion	6 (13)
Radial avulsion	3 (7)

Abbreviations: DRF, distal radius fracture; TFCC, triangular fibrocartilage complex; UIS, ulnar impaction syndrome.

Results

Functional Outcomes

On average, all patients demonstrated significant improvement on postoperative Q-DASH scores compared to preoperative scores (►**Table 2**). All patients also demonstrated improvement in active range of motion, but this did not reach statistical significance. In addition, Q-DASH score had a significant positive correlation with postoperative pain relief ($r = 0.85, p < 0.001$). In contrast range of motion parameters failed to correlate with postoperative pain following USO.

Determinants of Pain before Undergoing Surgery

Male patients, smokers, patients involved in worker compensation claims, patients with injury to the dominant side, and patients with type 3 DRUJ had significantly more pain (►**Table 3**).

Volar tilt and radial inclination demonstrated a negative correlation with pain (less volar tilt and less radial inclination resulted in more pain). This correlation was statistically significant and was present in both cohorts.

Factors that did not result in increased pain included age, body mass index (BMI), patients consuming opioids on daily basis, type of employment, type of diagnosis (idiopathic vs. DRF), ulnar variance, presence of TFCC injury, or type of TFCC injury. Among patients with UIS after DRF, ulnar variance, radial height, and radial inclination did not correlate with pain.

Regression analysis for preoperative covariates with statistical significance explained 28% of the variability in preoperative pain ($X^2 = 74.4$, $p = 0.03$, $R^2 = 0.28$). Smoking status ($X^2 = 20.4$, $p = 0.02$) and pathology on the dominant hand ($X^2 = 23.1$, $p < 0.01$) were the only independent predictors of preoperative pain.

Predictors of Pain Relief after Undergoing Ulnar Shortening Osteotomy

Patients who used opioid analgesics daily, active laborers, smokers, and patients involved in worker compensation claims had significantly less pain relief after surgery (►**Table 4**). There

Table 2 Comparison of preoperative and postoperative clinical measures

Measure	Preoperative	Postoperative	Statistics (95% CI)
Pain	**6.1**	**2.2**	**t = 11.1 (3.1–4.5) $p < 0.0001$**
Q-DASH	**61**	**35**	**t = 6.2 (16.8–33.2) $p < 0.0001$**
Flex-Ext	117	126	t = 1.5 (−18.8–2.6) $p = 0.07$
Pron-Sup	147	152	t = 1.2 (−14–3.6) $p = 0.12$)

Abbreviations: CI, confidence interval; Q-DASH, Quick Disabilities of the Arm, Shoulder, and Hand score; Flex-Ext, total flexion-extension arc of motion; Pron-Sup, total pronation-supination arc of motion.
Note: Bold values highlight values that were statistically significant (i.e., $p < 0.05$).

Table 3 Correlations between preoperative pain and categorical variables in all patients with ulnar impaction syndrome

Variables	Pain level	Statistics (95% CI of difference)
Sex		**t = 1.95 (−0.03–2.4) $p = 0.03$**
Male	**6.6**	
Female	**5.4**	
Diagnosis		t = 1.12 (−0.5–2.0) $p = 0.12$
Idiopathic	6.2	
After DRF	5.5	
Dominant Side		**t = 2.3 (0.2–2.6) $p = 0.01$**
Yes	**6.6**	
No	**5.2**	
Opioid Use		t = 0.9 (−2.1–0.8) $p = 0.2$
Yes	6.5	
No	5.8	
Worker's Compensation		**t = 2.0 (−3.6–0.3) $p = 0.03$**
Yes	**7.4**	
No	**5.7**	
Employment Status		t = 0.703 (−0.9–1.9) $p = 0.5$
Active Laborer	6.4	
Active Nonlaborer	5.9	
Smoker		**t = 1.9 (−0.04–2.5) $p = 0.03$**
Yes	**6.8**	
No	**5.6**	
TFCC Injury		t = 0.7 (−1.9–0.9) $p = 0.30$
Yes	6.3	
No	5.8	

Abbreviations: CI, confidence interval; DRF, distal radius fracture; TFCC, triangular fibrocartilage complex.

was no difference in pain relief between patients with a TFCC injury and those without an injury; however, those who had TFCC ligament repair had less pain relief but the difference was not statistically significance. Patients undergoing arthroscopic debridement had similar pain relief compared to those without. Patients with osteotomy performed at the metaphysis had significantly more pain relief than patients that had diaphyseal osteotomy performed.

The only radiographic measures that correlated with pain relief after surgery were preoperative ulnar variance and amount of shortening. The correlation between shortening and pain relief was consistent in patients with idiopathic UIS and patients with UIS after DRF (►**Table 5**).

Factors that resulted in similar pain relief included, age, gender, BMI, surgery on the dominant side, DRUJ morphology, and diagnosis of idiopathic UIS versus UIS after DRF.

Regression analysis for postoperative covariates with statistical significance explained 61% of the variability in postoperative pain ($X^2 = 93.7$, $p < 0.01$, $R^2 = 0.61$). Smoking status ($X^2 = 15.1$, $p = 0.03$) and anatomic site of osteotomy ($X^2 = 14.9$, $p = 0.03$) were the only independent predictors of postoperative pain. Employment status demonstrated near-significance ($X^2 = 30.9$, $p = 0.07$) (►**Table 6**).

Complications: Seven patients requested hardware removal after 6 months (5 diaphyseal and 2 metaphyseal). One patient had nonunion requiring revision plating and bone grafting of the diaphyseal osteotomy. Data for this patient were used for preoperative analysis but was excluded from the postoperative analysis.

Discussion

The present study identified a number of patient and surgery specific characteristics associated with postoperative pain following USO. Overall, demographic factors played a significant role in predicting pain before surgery as well as pain relief after surgery.

Demographic and Socioeconomic Factors

As hypothesized, smoking was correlated with increased pain before surgery and with less pain relief after surgery. This was consistent in regression analysis models in which smoking status was the only independent factor that was significant in both preoperative and postoperative regression models. Smoking has been identified in the past as a predictor of nonunion, wound complications, and overall complication rates but not with increased pain after surgery. This finding reinforces the importance of patient counseling in the decision-making process for surgery.

History of narcotic consumption is well recognized to be associated with higher risk of complications, longer length of stay, worse postoperative pain, and prolonged narcotic consumption following total joint arthroplasty.[13,27] Consistent with our hypothesis, preoperative narcotic consumption was associated with a lower rate of pain relief following USO. Recent literature has also demonstrated similar detrimental effects of opiate exposure prior to upper extremity procedures.[28] Although not fully understood, narcotic prescription patterns

Table 4 Correlations between postoperative pain relief and categorical variables in all patients with ulnar impaction syndrome that underwent ulnar shortening osteotomy

Variables	Postoperative pain	Pain improvement (%)	Statistics (95% CI of difference)
Sex			t = 0.02 (−20.6–20.5) $p = 0.5$
Male	2.4	59.3%	
Female	2.2	59.3%	
Diagnosis			t = 0.05 (−21.7–20.6) $p = 0.51$
Idiopathic	2.3	59.1%	
After DRF	2.3	59.6%	
Dominant side			t = 0.7 (−28.5–13.3) $p = 0.30$
Yes	2.7	56.3%	
No	1.7	63.9%	
Opioid use			**t = 2.6 (6.7–53.3)** **$p = 0.005$**
Yes	**3.9**	**36.1%**	
No	**1.8**	**66.1%**	
Worker's compensation			**t = 3.2 (16.8–73.6)** **$p = 0.001$**
Yes	**5.1**	**19.2%**	
No	**1.9**	**64.5%**	
Employment status			**t = 3.0 (10.2–51.3)** **$p = 0.004$**
Active laborer	**3.3**	**43.4%**	
Active nonlaborer	**1.5**	**74.2%**	
Smoker			**t = 2.0 (0.28–41.1)** **$p = 0.03$**
Yes	**3.4**	**46.3%**	
No	**1.7**	**66.7%**	
TFCC injury			t = 0.4 (−19–28) $p = 0.40$
Yes	2.4	57.1%	
No	2.4	61.5%	
TFCC repair			**t = 1.8 (−4–55.7)** **$p = 0.04$**
Yes	**2.5**	**35.8%**	
No	**2.3**	**61.6%**	
Surgical technique			**t = 1.8 (−2.6–38)** **$p = 0.04$**
Metaphyseal	**1.7**	**69.5%**	
Diaphyseal	**2.7**	**51.8%**	

Abbreviations: CI, confidence interval; DRF, distal radius fracture; TFCC, triangular fibrocartilage complex.

among orthopaedic surgeons may be playing a critical role in the prolonged utilization of narcotics.[29–31] As such, this is a potentially preventable situation as we believe that the majority of patients with ulnar sided wrist pain from UIS are not typically prescribed narcotics for preoperative pain relief. This is very evident given newly published level 1 data that showed no benefit from opioid consumption for chronic orthopaedic conditions such as low back and knee pain.[32] Patients should be advised to wean off opioid medication before surgery or they risk suboptimal results from USO surgery.

Worker's compensation (WC) was associated with greater pre- and postoperative pain scores, and among these patients, the average pain score improved by only 19.2% following USO compared to 64.5% in non-WC patients. WC is well recognized to be associated with poor postoperative outcomes following upper extremity surgery[22,33] however, after controlling for confounding factors, logistic regression failed to identify WC as an independent predictor of either pre- or postoperative pain. This may be due to the small number of WC patients in this cohort (9/69, 13%). Dominant side pathology was an independent predictor of preoperative pain, but not postoperative pain. In contrast, employment type (i.e., active laborers) was associated with less postoperative pain relief; logistic regression showed a statistical trend that laborers were less likely to gain significant pain relief ($X^2 = 30.9$, $p = 0.07$). Taken together, these findings suggest that WC status and associated factors likely play an important role in postoperative pain relief following USO.

Table 5 Correlations between postoperative pain relief and continuous variables among patients with ulnar impaction syndrome secondary to distal radius fracture

	Pearson Correlation (r)	*p*-value
Preoperative UV	**0.35**	**0.05**
Postoperative UV	−0.46	0.40
Shortening	**0.37**	**0.04**
Volar tilt	−0.13	0.30
Radial height	0.03	0.40
Radial inclination	−0.21	0.40
Q-DASH	**0.85**	**<0.001**
Flexion-extension arc	0.2	0.07
Pronation-supination arc	0.1	0.2

Abbreviations: Q-DASH, Quick Disabilities of the Arm, Shoulder, and Hand (DASH) score; UV, ulnar variance.

Table 6 Independent variables investigated with multinomial regression analysis

Variable	X^2	*p*-Value
Worker compensation	8.7	0.20
Smoker	15.1	0.03
Opioid use	7.9	0.20
Employment status	30.9	0.07
TFCC repair	6.2	0.30
Osteotomy site	14.9	0.03

Overall model statistics: $X^2 = 93.7$, $p = 0.009$, McFadden Pseudo $R^2 = 0.61$.

Functional and Disability Factors

The present cohort demonstrated significant improvement between pre- and postoperative Q-DASH scores. In addition, Q-DASH demonstrated to have a significant positive correlation with pain relief following USO for UIS. The ability to perform the activities addressed in the validated Q-DASH questionnaire is likely to be affected by the presence of pain. As such, patients with improved pain are less likely to report perceived disability and impaired function.[34] Improvement in range of motion did not correlate with pain relief. In the present cohort, there was no significant improvement in ROM, and preoperative ROM was well within the functional range of motion of the wrist. Taken together, positive ulnar variance and associated pain does not appear to significantly affect range of motion; however, further studies are warranted to better characterize the impact of USO on wrist ROM and function.

Anatomic and Surgical Factors

Less volar tilt and radial inclination resulted in more pain at time of initial diagnosis; this was present in patients with idiopathic UIS and patient with UIS after DRF. This is a critical point to discuss with patients that elect to treat DRF without surgery, and it is an even more important variable that surgeons need to correct when treating these fractures surgically. A possible explanation is that loss of normal volar tilt may result in some DRUJ incongruence that is not appreciable on radiographs given how variable the DRUJ anatomy can be. Ulnar shortening potentially restores DRUJ congruence and lessens pain from that source.

Both the preoperative ulnar variance and the amount of shortening achieved during surgery did correlate with pain relief. This was an unexpected finding because the numeric range is very small given that the goal of the surgery is to obtain a UV of 0 to −2 mm. This suggests that pain relief from USO may not only result from just the mechanical unloading of the carpus, but also from tensioning the ulnar collateral ligaments of the wrist, the ECU subsheath and the radioulnar ligaments.[35,36] Similarly, TFCC repair did not result in better pain relief, which supports the thinking that TFCC tears in the setting of UIS is degenerative and does not benefit from repair unless there is gross DRUJ instability after shortening is performed.[12,37,38] In fact, some literature supports the use of USO without TFCC repair to treat TFCC tears in the setting of positive UV.[39,40]

Patients that underwent a metaphyseal osteotomy demonstrated significantly lower postoperative pain scores compared to those who underwent diaphyseal osteotomy. Patients undergoing metaphyseal osteotomy had slightly more shortening than diaphyseal patients (4.3 mm vs. 3.3 mm). This is likely an incidental finding inherent to the cohort rather than the technique itself, but given the aforementioned correlation with pain relief and amount of shortening, this small difference may account for some of the difference in pain relief between techniques and warrants further investigation. In addition, a metaphyseal shortening osteotomy is done distal to the distal oblique band of the interosseous membrane, less force is required for shortening and adequate tensioning of the DRUJ ligaments can be achieved without interfering with the interosseous membrane. In contrast, shortening at the diaphysis with the use of predesigned systems may disrupt the interosseous membrane and anecdotally requires greater force to achieve shortening. Although subtle, this may be a source of pain that counteracts the relieving effect of shortening and ongoing research by our group is focused on better characterizing these parameters.

UIS is still poorly understood and the simple hypothesis of increased ulnar load across the wrist may only be one of the factors. We hypothesize that patients with more positive preoperative UV had more severe disease overall (more DRUJ incongruence, more ligament stretching, etc.). By performing ulnar shortening not only is the ulnar side of the wrist mechanically unloaded but the ulnar collateral ligaments, the ECU subsheath and the radioulnar ligaments are also retightened and stabilized. However, it is important to note that the correlation between shortening and pain relief was weak (Pearson r 0.2–0.39 is considered weak by statistical consensus) and as mentioned above, demographic factors and disability scores played a more important role in predicting pain relief.

The present study has several weakness and shortcomings. The location of USO (metaphyseal vs. diaphyseal) was not randomized and the decision for either procedure was based on surgeon preference and experience. Psychological influence on pain intensity was not assessed.[41,42] The long-term outcomes following either metaphyseal or diaphyseal USO were not assessed. Twenty-nine patients had 1-year follow-up and the average pain score did not differ from the 6-month pain score (2.8 vs. 2.3, $p > 0.05$); however, this sample is too small to perform the robust statistical analyses that we were able to do at 6 months. TFCC tears were classified according to the anatomic descriptions found in the operative reports which correspond to Palmer class 1 tears.[43] Although this classification is classically used for traumatic tears, it allowed the data to be uniformly classified for analysis and to determine the impact of TFCC repair. Lastly, due to the retrospective nature of the study, the amount and length of postoperative opiate consumption was not assessed, which could provide further insight into the impact of narcotic consumption in pain relief following USO.

The present study is the combination of a complex analysis of factors that correlate with the level of pain at time of diagnosis (level II diagnostic study) and comparison of factors that predict pain relief after the intervention (level III therapeutic). The results presented help to further characterize the complex relationship between patient characteristic and surgical technique in patients undergoing USO for UIS. Tobacco utilization and preoperative opiate consumption were predictive of pain and pain relief following USO. Although the severity of ulnar variance was associated with pain relief, it was not found to be an independent predictor of pain. The importance of smoking cessation is paramount in the success of this surgery not only to prevent delayed/nonunion but we know now it will affect overall outcome. WC and associated factors including active laborers and dominant side pathology are likely to play a role in postoperative pain, but further large-scale trials are warranted in this unique patient population. Ultimately, the increasing awareness of opiate prescribing patterns will help both surgeons and patients discuss expectations of narcotic consumption and pain control following upper extremity procedures.

Conflict of Interest

Dr. Li reports other from DT medtach, other from Keranetics, outside the submitted work; and American Society for Surgery of the Hand: Board or committee member. All other authors reported no conflict of interest.

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